THAT WHICH IS CLAIMED IS:

1. A method of hydrogenating a polymer, comprising the steps of:

(a) providing a dense phase, said dense phase comprising a polymer in an organic solvent;

(b) providing a catalyst system, said catalyst system comprising at least one metal hydrogenation catalyst selected from the group consisting of Nickel and Ruthenium immobilized on a solid support; and

(c) providing a light phase, said light phase comprising hydrogen and carbon dioxide; and

(d) contacting said dense phase, said light phase and said catalyst system so that said hydrogen reacts with said polymer and said polymer is hydrogenated.

2. The method of claim 1, wherein said polymer is selected from the group consisting of polystyrene, poly(bisphenol A carbonate), poly(ethylene terephthalate), polybutadiene and copolymers thereof, and polyisoprene and copolymers thereof.

3. The method of claim 1, wherein said solid support is formed from carbon, silica, alumina, silica-alumina, calcium carbonate or barium sulfate.

4. The method of claim 1, wherein said at least one metal hydrogenation catalyst further comprises a catalyst selected from the group consisting of platinum, palladium, rhodium, copper, molybdenum rhenium, tungsten, cobalt, and mixtures thereof

5. The method of claim 1, wherein said metal hydrogenation catalyst is nickel.

6. The method of claim 1, wherein 0.1 to 1 weights of catalyst per weight of polymer are included in said contacting step.

7. The method of claim 1, wherein from 0.1 to 20 weight percent of said polymer is included in said dense phase.

8. The method of claim 1, wherein said contacting step is carried out at a carbon dioxide pressure of 100 to 3000 psi.

9. The method of claim 1, wherein said contacting step is carred out at a hydrogen pressure of 100 to 2000 psi.

10. The method of claim 1, wherein the viscosity of said dense phase at reaction temperature prior to said contacting step is from 1 to 100 centipoise, and wherein the viscosity of said dense phase after said contacting step decreased by at least half thereof.

11. The method of claim 1, wherein said light phase comprises a gas or supercritical fluid.

12. The method of claim 1, wherein said dense phase comprises a liquid.

13. The method of claim 1, wherein said contacting step is carried out at a temperature of 0 to 300 °C.

14. The method of claim 1, wherein said contacting step is a batch contacting step.

15. The method of claim 1, wherein said contacting step is a continuous contacting step.

16. The method of claim 1, wherein said contacting step is carried out in slurry reactor.

17. The method of claim 1, wherein said contacting step is carried out in a fixed bed reactor.

18. The method of claim 1, wherein said contacting step is carried out in a fixed bed reactor selected from the group consisting of trickle bed reactors and two-phase upflow reactors.

19. A method of hydrogenating a polymer, comprising the steps of:

(a) providing a liquid dense phase, said dense phase consisting essentially of a polymer in an organic solvent, said polymer selected from the group consisting of polystyrene, poly(bisphenol A carbonate), poly(ethylene terephthalate), polybutadiene and copolymers thereof, and polyisoprene and copolymers thereof, with said solvent included in said dense phase in an amount of from 0.1 to 20 weight percent;

(b) providing a solid catalyst system, said catalyst system comprising at least one metal hydrogenation catalyst selected from the group consisting of nickel and ruthenium immobilized on a solid support; and

(c) providing a gas or supercritical fluid a light phase, said light phase consisting essentially of hydrogen at a pressure of 100 to 2000 psi and carbon dioxide at a pressure of 100 to 3000 psi; and

(d) contacting said dense phase, said light phase and said catalyst system at a temperature of 50 to 300 ° C, and in an amount of 0.1 to 1 weight of catalyst system per weight of polymer, to react said hydrogen with said polymer hydrogen and hydrogenate said polymer.

20. The method of claim 19, wherein the viscosity of said dense phase prior at reaction temperature to said contacting step is from 1 to 100 centipoise, and wherein the viscosity of said dense phase after said contacting step is decreased by at least half thereof.

21. The method of claim 19, wherein said contacting step is a batch contacting step.

22. The method of claim 19, wherein said contacting step is a continuous contacting step.

23. The method of claim 19, wherein said contacting step is carried out in slurry reactor.

24. The method of claim 19, wherein said contacting step is carried out in a fixed bed reactor.

25. The method of claim 19, wherein said contacting step is carried out in a fixed bed reactor selected from the group consisting of trickle bed reactors and two-phase upflow reactors.

26. The method of claim 19, wherein said polymer is polystyrene, which polystyrene is hydrogenated to produce polycyclohexylethylene.